A8

dV/dt (liq loop)	=	dm/dt(liq loop) / 60 / dens@4V/.1337 **25.3** gpm
dm/dt (total)	=	dm/dt(liq loop) / (1-x) **9924** #/hr
dV/dt (total) (compressor inlet)	=	dm/dt(total) / 60 / dens@1 **1034** acfm

Please remove Fig. 3 and Fig. 5 from the present application and substitute therefor the attached drawings marked Fig. 3 and Fig. 5.

Remarks

The foregoing amendment is submitted to correct typographical errors, label certain tables included in the Specification, and correct the identification of certain elements shown in the drawings. No new matter has been added. Submitted herewith is a marked up version of the paragraphs amended in accordance with the requested preliminary amendment. Please enter the foregoing preliminary amendment prior to examination of the present application. Favorable action is respectfully requested.

Respectfully Submitted,

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12129-00013
PATENT

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Applicant: Winkler et al.	:	Art Unit: 3744
Serial No.: 09/844,072	:	Examiner:
Filed: April 27, 2001	:	
For: PROCESS AND APPARATUS FOR ACHIEVING PRECISION TEMPERATURE CONTROL	:	

CERTIFICATE OF MAILING

I certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on August 23, 2001.

Patrick W. Rasche

Patrick W. Rasche
Reg. No. 37,916]

SUBMISSION OF MARKED UP PARAGRAPHS

Hon. Assistant Commissioner for Patents
Washington, D.C. 20231

Submitted herewith are marked up paragraphs in accordance with 37 C.F.R. 1.21(c)(ii) and 1.121(b)(iii), in furtherance of the Preliminary Amendment.

IN THE SPECIFICATION

Please delete the paragraph starting on page 6, line 3, and ending on page 6, line 6, and beginning with the words, "A pair of manual valves" and substitute therefor the following paragraph.

A pair of manual valves 216 and 218 are normally closed; and a pair of manual valves 220 and 222 are normally open, unless facility backup cooling is used, in which case these

settings are reversed. In alternative embodiment, valves 216, 218, 220, and 222 are not utilized and sensor 208 is located in reservoir 232.

Please delete the paragraph starting on page 6, line 13, and ending on page 6, line 15, and beginning with the words, "A pump" and substitute therefor the following paragraph.

A pump 230 draws fluid from a reservoir [232] 202 and delivers it through heat exchanger 228, where it is cooled to the required temperature. A relief valve 234 protects heat exchanger 228 from overpressure.

Please delete the paragraph starting on page 6, line 25, and ending on page 6, line 28, and beginning with the words, "Heat load" and substitute therefor the following paragraph.

Heat load 206 receives the fluid, precisely regulated at the desired temperature and flow setpoints, and adds heat to the process fluid, raising its temperature except for when the heat-load is temporarily off. The fluid then returns to reservoir [232] 202.

Please delete the paragraph starting on page 7, line 1, and ending on page 7, line 8, and beginning with the words, "Figure 3" and substitute therefor the following paragraph.

Figure 3 is a schematic illustration of a temperature control apparatus 300 for achieving precision temperature control of fluids. A temperature controller 344 compares its setpoint to the value from a sensor 342, and uses that comparison to control the position of flow control valves 326 and [346] 352, which determine the mixing ratio of hot and cold sources from reservoirs 328 and 302. Flow control valves 326 and [346] 352 positions are inversely related; as valve 326 opens, valve [346] 352 closes, and vice versa. The inverse relationship is accomplished with dual signals from controller 344, with one valve being controlled with inverse logic compared to the other.

Please delete the paragraph starting on page 9, line 8, and ending on page 9, line 14, and beginning with the word, "Reservoir" and substitute therefor the following paragraph.

Reservoir 402 is sized to provide the appropriate amount of thermal inertia for the system. In one embodiment reservoir 402 includes a circulation pump to reduce thermal stratification within the reservoir. Manual valves 416 and 418 are normally closed, while manual valves 420 and 422 are normally open. In an alternative embodiment, these settings are reversed if facility backup cooling is used. A variable displacement pump 424 draws fluid from reservoir and delivers it to the final control location.

Please delete the paragraph starting on page 13, line 11, and ending on page 13, line 13, and beginning with the words, "The method" and substitute therefor the following paragraph.

The method of calculating a particular application's required distinct points of resolution is displayed in [Table 1] Design Variation #1, and illustrated in the following sample calculation.

Please delete the paragraphs starting on page 14, line 4, and ending on page 14, line 12, and beginning with the words, "ΔFlow/ΔTemp" and substitute therefor the following paragraphs.

$$
\begin{aligned}
\Delta\text{Flow}/\Delta\text{Temp} &= [\text{Flow}_{total} * (T_{hot} - (T_{nom} - .01)) / (T_{hot} - T_{cold})] - \text{Flow}_{cold} \\
&= [39\text{gpm}* (88°\text{F} - (75°\text{F} - .01°\text{F})) / (88°\text{F} - 73°\text{F})] - 33.8[\text{o}]\underline{0}\text{gpm} \\
&= \underline{0}.0260\text{gpm}/.01°\text{F}
\end{aligned}
$$

$$
\begin{aligned}
\text{Valve Travel\%} &= 100*(\Delta\text{Flow}/\Delta\text{Temp} / \text{Flow}_{cold}) \\
&= 100*(.0260\text{gpm}/.01°\text{F} / 33.80\text{gpm}) \\
&= \underline{0}.077\%
\end{aligned}
$$

Please delete the tables and calculations starting on page 14, line 21, and ending on page 16, line 23, and beginning with the first column header entitled, "Deviation" and substitute therefor the following tables and calculations.

Design Variation #1

DEVIATION	TEMP F		FLOW %		GPM		DGPM/.01	%	REQUIRED
COLD HOT	COLD	HOT	COLD	HOT	COLD	HOT	MIX	VALUE TRAVEL	RESOLUTION
NOM/NOM	73	88	86.67	13.33	33.80	5.20	0.0260	0.077	1500
LOW/LOW	72	87	80.00	20.00	31.20	7.80	0.0260	0.083	1500
LOW/HIGH	72	89	82.35	17.65	32.12	6.88	0.0229	0.071	1700
HIGH/LOW	74	87	92.31	7.69	36.00	3.00	0.0300	0.083	1300
HIGH/HIGH	74	89	93.33	6.67	36.40	2.60	0.0260	0.071	1500
									1700

Design Variation #2

DEVIATION	TEMP F		FLOW %		GPM		DGPM/.01	%	REQUIRED
COLD HOT	COLD	HOT	COLD	HOT	COLD	HOT	MIX	VALUE TRAVEL	RESOLUTION
NOM/NOM	70	87	N/A	N/A	40.00	39.00	0.0769	0.128	780
Flow valve's resolution based on valve sized for 100% open at 60 GPM									**780**

Design Variation #3

DEVIATION	TEMP F		FLOW %		GPM		DGPM/.01	%	REQUIRED
COLD HOT	COLD	HOT	COLD	HOT	COLD	HOT	MIX	VALUE TRAVEL	RESOLUTION
NOM/NOM	73	88	86.67	13.33	33.80	5.20	0.0260	0.260	385
LOW/LOW	72	87	80.00	20.00	31.20	7.80	0.0260	0.260	385
LOW/HIGH	72	89	82.35	17.65	32.12	6.88	0.0229	0.229	436
HIGH/LOW	74	87	92.31	7.69	36.00	3.00	0.0300	0.300	333
HIGH/HIGH	74	89	93.33	6.67	36.40	2.60	0.0260	0.260	385
Hot flow valve's resolution based on valve sized for 100% open at 10 GPM									**436**

Design Variation #4

DEVIATION	TEMP F		FLOW %		GPM		DGPM/.01	%	REQUIRED
COLD HOT	COLD	HOT	COLD	HOT	COLD	HOT	MIX	VALUE TRAVEL	RESOLUTION
NOM/NOM	73	88	86.67	13.33	33.80	5.20	0.0260	0.260	385
LOW/LOW	72	87	80.00	20.00	31.20	7.80	0.0260	0.260	385
LOW/HIGH	72	89	82.35	17.65	32.12	6.88	0.0229	0.229	436
HIGH/LOW	74	87	92.31	7.69	36.00	3.00	0.0300	0.300	333
HIGH/[LOW] HIGH	74	89	93.33	6.67	36.40	2.60	0.0260	0.260	385
Hot flow valve's resolution based on valve sized for 100% open at 10 GPM									**436**

NOTE: A low value of required resolution is desirable because it produces higher sensitivity.

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Example Calculations for Design Variation #5:

Given: A user must remove 350kW @ -100°F from a cold plate. Design ambient condition is 100°F. Based on an analysis of potential refrigerants, ethane is selected due largely to operating at reasonable pressures and a high high heat of vaporization.

Design Variation #5

		Customer Load = 350 kW				
	ETHANE		Qcust = 1.19E+06 Btu/hr			
CYCLE POINT	**T (°F)**	**P (pisa)**	**H (Btu#)**	**liq/vap (mass %)**	**Dens ($\#/ft^3$)**	
1	100	31.3	468	-	0.16	
1c	280	175	534	-	-	
1'	120	175	466	-	-	
2	240	1500	465	-	-	
2'	120	1500	346	-	-	
3	0	1500	252	-	-	
4	-100	31.3	252	-	-	
4V	-100	31.3	389	0.33		
4L	-100	31.3	187	0.67	32.7	
5	(from graph, use h5 below)				0.88	

Dh (hex cold side) = dh (hex warm side)
= (h2'-h3)
= **94.0**

dh (hex cold side) = x(hl-h4V) + (1-x)(h[i]1-h5)
94.0 = x(hl-h4V) + (1-x)(hl-h5)
solving for h5... h5 = **366.6**

solve for quality @ point 5 (shown in table)

dh (cust load) = h5-h4L
179.6

dm/dt (liquid loop) = Qcust / dh(cust load)

		6649 #/hr
dV/dt (liq loop)	=	dm/dt(liq loop) / 60 / dens@4V/.1337 **25.3** gpm
dm/dt (total)	=	dm/dt(liq loop) / (1-x) **9924** #/hr
dV/dt (total)	=	dm/dt(total) / 60 / dens@1
(compressor inlet)		**1034** acfm

Please remove Fig. 3 and Fig. 5 from the present application and substitute therefor the attached drawings marked Fig. 3 and Fig. 5.

Respectfully Submitted,

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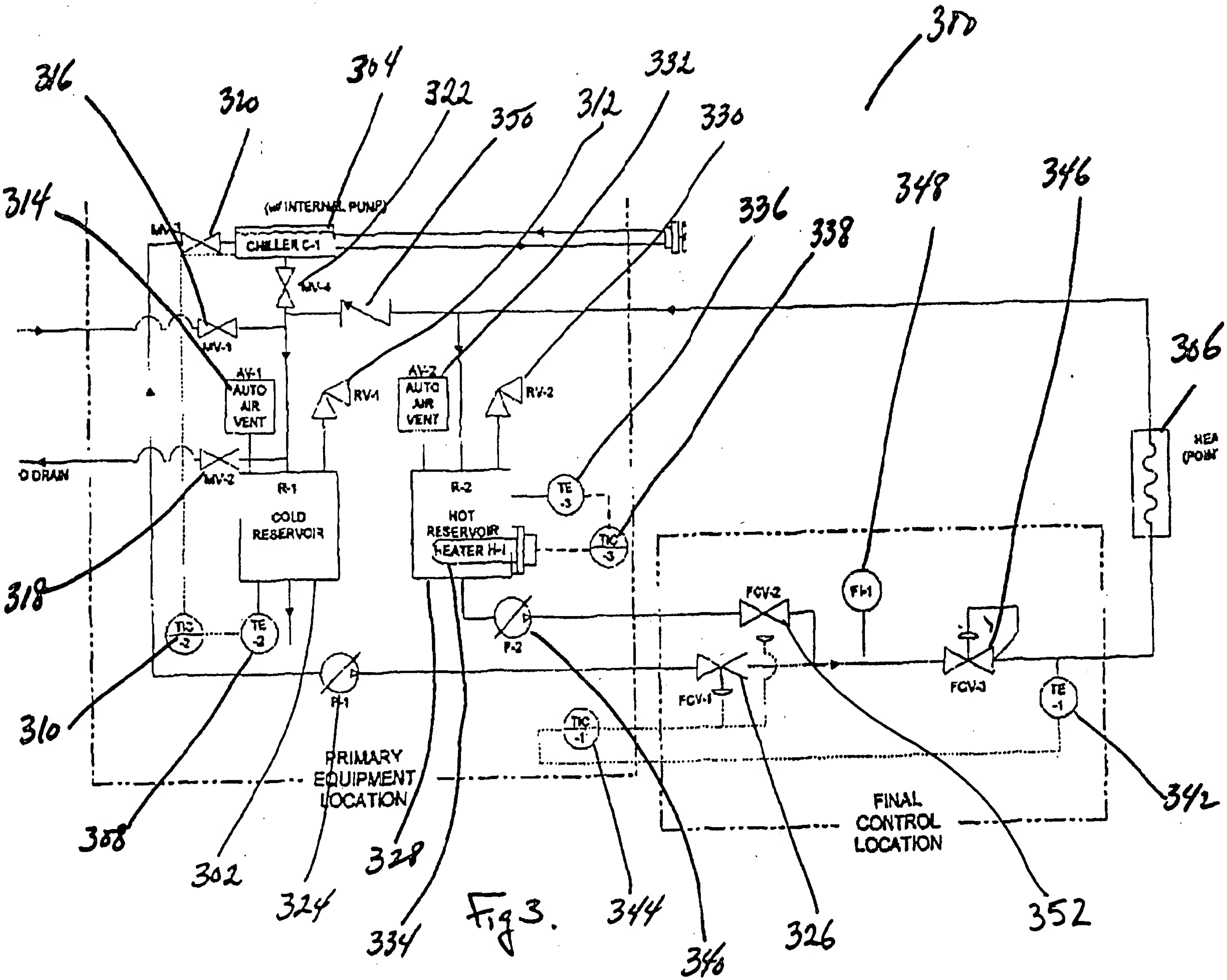
300
316
320
304
322
356
312
332
330
314
(w/ INTERNAL PUMP)
CHILLER C-1
MV-1
MV-4
AV-1
AUTO
AIR
VENT
RV-1
AV-2
AUTO
AIR
VENT
RV-2
336
338
348
346
306
O DRAIN
MV-2
R-1
COLD
RESERVOIR
R-2
HOT
RESERVOIR
HEATER H-1
TE
-3
TIC
-3
318
TIC
-2
TE
-2
P-1
P-2
FCV-2
FI-1
FCV-1
FCV-3
TE
-1
TIC
-1
310
PRIMARY
EQUIPMENT
LOCATION
FINAL
CONTROL
LOCATION
342
308
302
324
328
334
344
346
326
352
Fig 3.

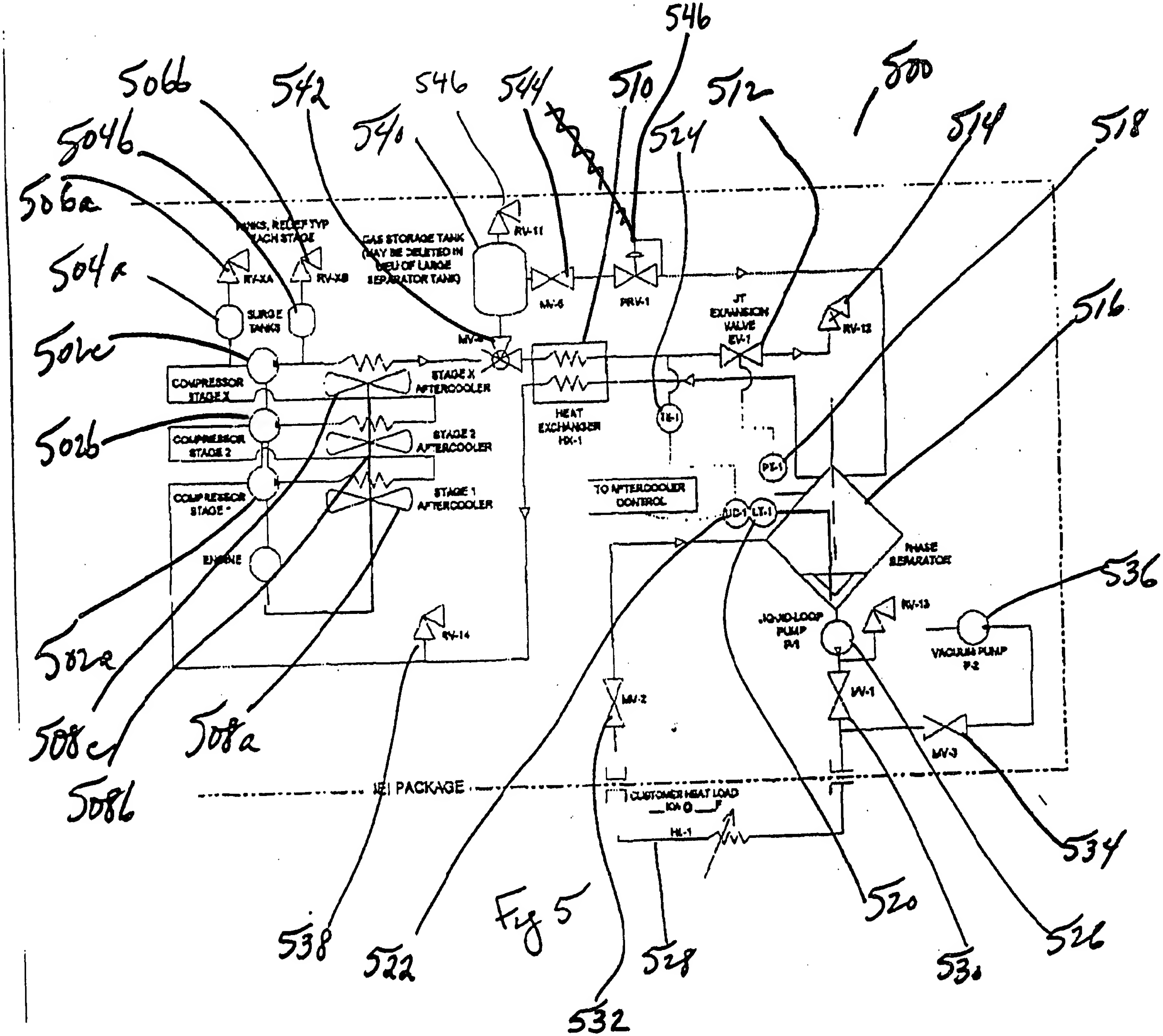
500
502a
502b
502c
504a
504b
506a
506b
508a
508b
508c
510
512
514
516
518
520
522
524
526
528
530
532
534
536
538
540
542
544
546
TANKS, RELIEF TYP EACH STAGE
RV-XA
RV-XB
SURGE TANKS
COMPRESSOR STAGE X
COMPRESSOR STAGE 2
COMPRESSOR STAGE 1
ENGINE
STAGE X AFTERCOOLER
STAGE 2 AFTERCOOLER
STAGE 1 AFTERCOOLER
RV-14
GAS STORAGE TANK (MAY BE DELETED IN LIEU OF LARGE SEPARATOR TANK)
RV-11
MV-6
PRV-1
HEAT EXCHANGER HX-1
TE-1
JT EXPANSION VALVE EV-1
RV-12
PT-1
TO AFTERCOOLER CONTROL
LT-1
PHASE SEPARATOR
RV-13
LIQUID LOOP PUMP P-1
VACUUM PUMP P-2
MV-1
MV-2
MV-3
CUSTOMER HEAT LOAD
HL-1
IEI PACKAGE

Fig 5